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ABSTRACT

This research paper examines the potential for asynchronous learning networks as a viable training alternative for small and medium manufacturing businesses. This first phase of the project, conducted by the Colorado Community College and Occupational System and the National Association of Manufacturers reviews existing research with a specific objective to help the project team: (1) create asynchronous learning networks for small manufactures whose employees lack formal education and who have limited access to technology; (2) understand how to overcome barriers to learning; and (3) find ways to use online technology effectively. Findings from the literature review included the following. Asynchronous learning is a complex process. Characteristics of successful distance learners differ from those in the target population. Distance learning initiatives have higher attrition rates than other forms of learning. Business and learner needs assessment and up-front development time is critical for teachers to determine the required skills. Media choice is not a primary factor in success of learning. More traditional teaching factors, such as teacher interaction and curriculum, have a greater impact on students' success than the actual technology. The success of any asynchronous learning program will depend first on understanding the needs of the businesses involved and the learning needs and learning styles of the target populations. Implications for policymakers are presented. Contains 14 figures. (Author/JA)

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Asynchronous Learning in Manufacturing
Review of Research

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Asynchronous Learning in Manufacturing
Review of Research
Executive Summary

Background and Scope. The Colorado Community College and Occupational Education System and the National Association of Manufacturers received a grant from the Alfred P. Sloan Foundation to study the potential for asynchronous learning networks as a viable training alternative for small and medium manufacturing businesses. This first phase of the project reviews existing research with a specific objective to help the project team: (1) create asynchronous learning networks for small manufacturers whose employees lack formal education and who have limited access to technology; (2) understand how to overcome barriers to learning; and (3) find ways to use on-line technology effectively.

Methodology. The general literature scan includes: review of distance learning journals and books; 68 asynchronous learning web sites; the Sloan Foundation's database of grant winners; and bibliographies of historical studies. Since few studies specifically addressed asynchronous learning for line employees in manufacturing, this review focused on literature related to learning barriers. Application to the workplace is often inferred.

Findings.

Organization Learning Models. Asynchronous learning is a complex process. Each individual student is learning within the limits and strengths of his or her own cognitive and affective skills, but is being challenged to develop new interactive learning skills and keep pace with busy production lines. Business and learner needs assessment and up-front development time is critical for teachers to determine the required skills.

Learner Characteristics.

- Characteristics of successful distance learners are different from the characteristics of the target population of line employees in small manufacturing firms. Line employees, on the surface, look more like the profile of people with low success in long distance learning.
- Distance learning initiatives have higher attrition rates than other forms of learning.
- The target population for this study is more likely to contain concrete (or social) learners and have a low academic self-concept. In their first interactions with the system, they will require clearly stated expectations, firm structure, and frequent feedback from the teacher.

Development of Instruction.

- Media choice is not a primary factor in success of learning. Most literature and field studies conclude that more traditional teaching factors, such as teacher interaction and curriculum design, have a greater impact on students' success than the actual technology.

Teacher Competencies.

- Teachers require special talent in structuring curriculum, helping students understand expectations, providing concrete problem-solving, and managing remote discussion and field work.
- Teachers need to work closely with workers' supervisors to ensure support.

Instructional Design.

- Business needs, student needs, and content areas need to be determined before the media are selected.
- Design must account for the business needs, the variance among students' cognitive and affective learning styles, the lack of physical learning readiness clues, and the need to help students negotiate the media interfaces.
- Content strategy and media choices should enhance the type of information-sharing and problem-solving choices actually faced by the worker-learner.

The Study Guide.

- The Study Guide (which is separate from curriculum) is a key tool for breaking barriers for the long distance learner. It provides very detailed descriptions of course, outcomes, logistics, study hints, jokes, and anticipation of learning problems.

Effective Use of Media Technology.

- A variety of media are available – each with its own interface and cost issues.
- Computer technology creates additional hurdles for new students, including access, keyboarding, reading, and new logic flows. Ease of interface and low-cost access may be crucial factors for learners with lower self-confidence.
- Programs using networked computers require assistance with technology start-up to be available for at least three weeks and may require a separate media orientation session.

Implications for Policy Makers.

- The evolution of networked computers as a tool for economic development and asynchronous learning is still in its infancy. The success of any asynchronous learning program will depend first on understanding the needs of the businesses involved and the learning needs and learning styles of the target populations.
- Programs targeting adults with little previous academic success will need to incorporate into their curriculum design strategies for overcoming barriers to learning. Policy makers promoting development in this area must ensure that their program and resource decisions will enhance the learning ability of the targeted learner group.
- Technology alone does not create successful programs. Be careful not to invest in specific technologies until educational learning needs and objectives are understood.
- Asynchronous learning programs do require different kinds of institutional support for students and teachers.
- Successful programs will be closely tied to actual problems encountered in the changing workforce. The materials will be application-oriented, and will help the individual understand how to gain new skills, use those skills, and share them. Some courses may need to have basic skills built into them.

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Asynchronous Learning in Manufacturing
Review of Research

Colorado Community College and Occupational Education System
National Association of Manufacturers
Alfred P. Sloan Foundation

I. Introduction

Background. The Colorado Community College and Occupational Education System (CCCOES) and the National Association of Manufactures received a grant from the Alfred P. Sloan Foundation to study the potential for asynchronous learning networks (ALN) as a viable training alternative for small and medium manufacturers.* Competition puts pressure on these firms to increase employee training. However, many are not large enough to have in-house training staffs. They may be so small that a small class jeopardizes production, or they may be too geographically dispersed to take advantage of campus training. ALN techniques hold the potential for community colleges to extend services to include incorporation of modules into business production cycles, creative use of individual learning time, and aggregation of class delivery across many small firms.

Policy Issues. Policy makers have a keen interest in the interrelated issues of economic and workforce development. Smaller manufacturers play a critical role in regional economies, and community colleges have had success in helping their employees gain basic education and technical skills training. Public investments in asynchronous learning based on use of computer networks has escalated over the past five years. Policy makers need appropriate data to ensure that these new ways to deliver education will continue to serve a workforce requiring basic education and technical skills training.

Scope of Report. This report reviews existing asynchronous learning research with a specific objective of finding data to help the project team: (1) develop asynchronous learning networks for small manufacturers whose employees lack formal education and who have limited access to technology; (2) understand how to overcome the target population's barriers to learning; and (3) find ways to use on-line technology effectively.

Methodology and History. This literature scan reviewed: distance learning journals and books; 68 asynchronous learning web sites; the Sloan Foundation's database of grant winners; and bibliographies of historical studies. Generally, research reviewed was conducted between 1988 and 1998. Most statistical studies have been academic. Sample sizes are small, course- or program-specific, technology-specific, and not totally reliable for extrapolation to the project's client base.

Historically, distance education began with correspondence courses. Extensive research exists on the use of print, television, and telephone. On-line technology for education has only come into its own since 1994, when the World Wide Web simplified access and more people purchased personal computers. To date, on-line applications have been mostly academic,

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* "Asynchronous" means that students access remote learning resources at their convenience, using a variety of technologies to time-shift their education. The phrase "learning network" describes (1) people who are remote from each other, yet still learn together, and (2) the technology that enables the communication. The phrase "distance learning" is used interchangeably with asynchronous learning networks in this report.

serving computer-literate professionals, such as engineers. Research assessing the impact of on-line technology on people who have not been academically successful is still in its infancy.

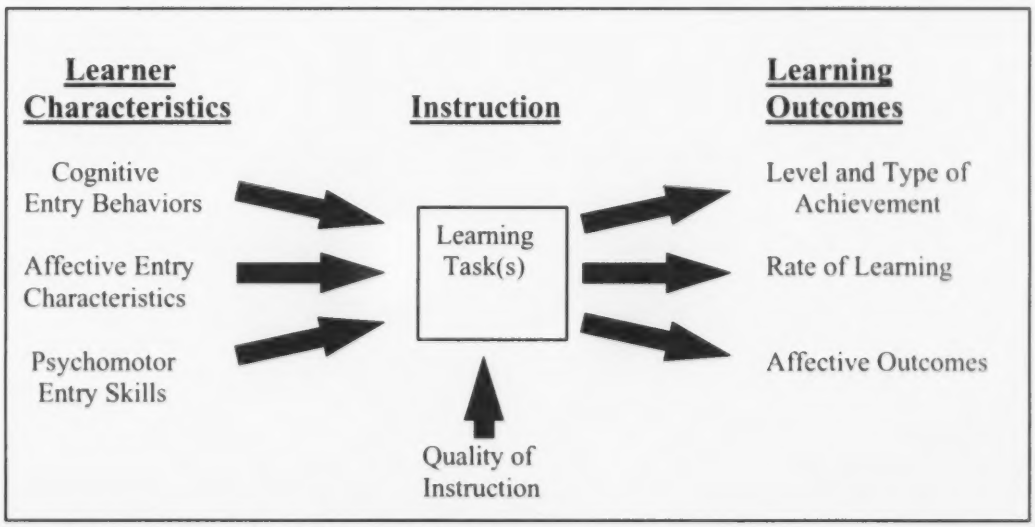
While larger businesses are actively developing on-line courses delivered through corporate intranets, the business training trade press tends to focus on success stories and on technology issues; it does not yet have statistical studies addressing learning barrier issues. Since few studies address asynchronous learning for manufacturing line employees, the review research included: academic studies focusing on success and failure factors; military training; and literature from countries which have a tradition of distance learning for people of many abilities. The workplace application is often inferred.

II. Organizing Models for Asynchronous Learning

Four learning models or theories provide context for studies on asynchronous learning: (1) a cognitive and affective behavior model; (2) a transactional distance theory; (3) an interactive learning model; and (4) a workplace training assessment model.

Cognitive and Affective Learning Model. Learning behavior models emphasize the importance of the cognitive and affective "entry" skills that a learner brings to a designated learning task (Bloom, 1976).[1] Subject content areas are divided into learning tasks which are comprised of terms, facts, rules and relationships, processes, translations, and applications, as well as the different degrees of structure and interrelationships among those elements. Development of quality instruction should include: (1) description of cognitive skills (e.g., knowledge or intellectual ability) required for a set of learning tasks; (2) specific strategies for discerning and overcoming barriers that are more affective (e.g., attitudes, values, emotions, feelings); and (3) an identification of required motor skills (e.g., keyboarding). Ideally, learners could be screened to ensure that they have the "right" entry skills. In practice, there's usually a gap between the developers' ideal entry skills and the learner's actual entry skills. Teachers and students spend much time negotiating this gap.

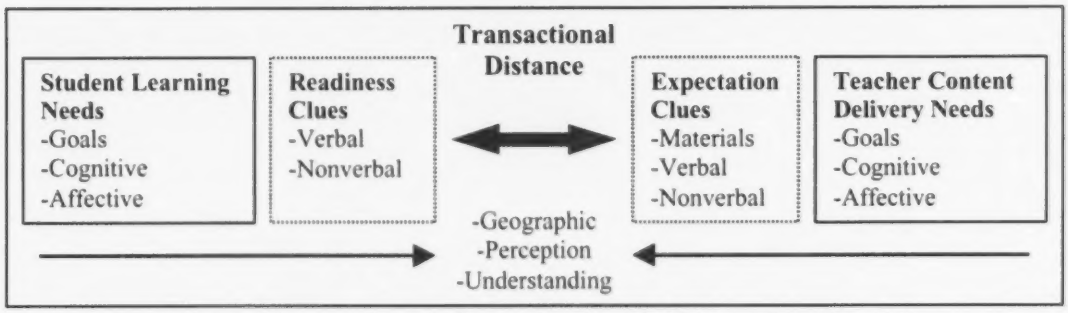
Figure 1: Cognitive and Affective Learning Model



Source: Bloom, Human Characteristics and School Learning, 1976.

Transactional Distance Theory. A major dilemma for long distance teachers is "transactional distance" which impacts the teacher's ability to identify non-verbal cues of a student's affective or cognitive readiness for the tasks (Moore, 1991).[2] Transactional distance means two things: (1) the geographic separation of learners and teachers, and (2) the distance between the perception and understanding of the learners and the perception and understanding of the teachers. Classroom teachers are accustomed to "making up" for their lack of knowledge about students' affective and cognitive abilities by reading those non-verbal cues and making adjustments during the class. Distance teachers do not have those cues, and have a harder time recognizing and "rescuing" learners in trouble.

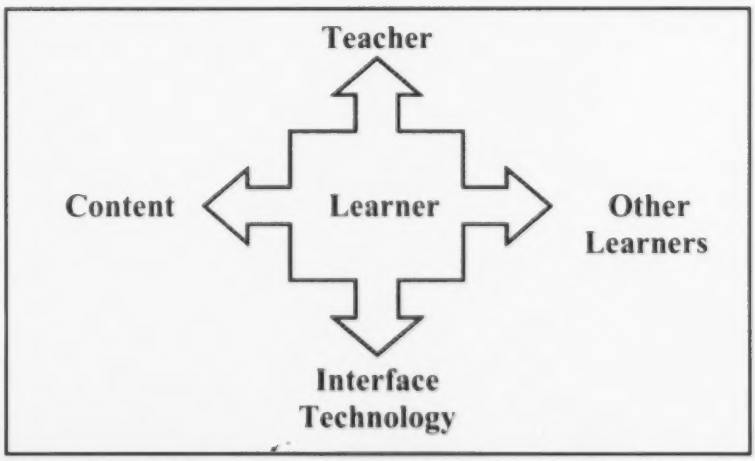
Figure 2: Transactional Distance Model



Source: Moore, "Distance Education Theory," The American Journal of Distance Education, 1991.

Four types of Learning Interaction. Hillman (1994) suggests that distance learners are heavily impacted by their interactions with the content, the teacher, with other learners, and with the delivery media interface technology, and that teachers must consciously help the learner mediate the four interactions.[3] *Most distance learning theorists believe that it is this conscious mediation which differentiates distance education from classroom education.*

Figure 3: Types of Interaction in Distance Education

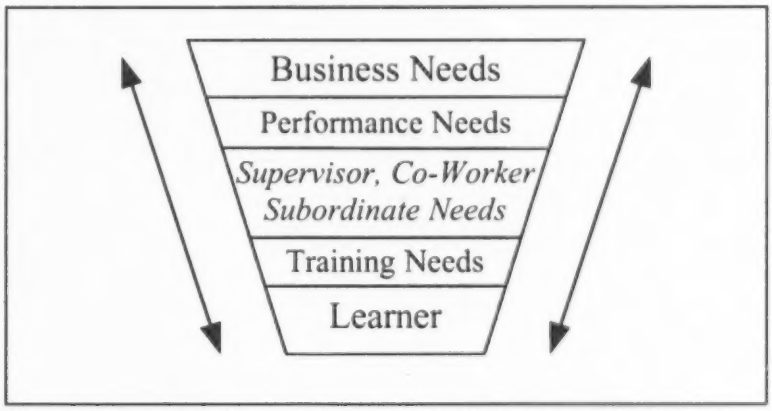


Source: Adapted from Hillman, Willis, and Gunawardena, "Learner-Interface Interaction in Distance Education," The American Journal of Distance Education, 1994.

Traditional classroom teachers tend to concentrate on the learner's interaction with the subject content. In asynchronous learning networks – especially those using computer technology – teachers must pay special attention to learners at the beginning of sessions to ensure that the interface technology is a help, not a hindrance. Teachers must also build in exercises that create interactions with other students. These exercises have two goals: create a social environment to fulfill learners' affective learning needs, and develop the network learning skills that are a part of the evolving competitive environment.

Workplace Performance Training Models. Education in the workplace adds additional complexity. Instructional design must not only take into consideration the needs of the individual learner, but also the organization's business goals and the performance desired from the learners (Robinson, 1996).[4] Worker-learners have a high need to apply what they've learned on the job while they are learning in order to reinforce the value of spending the time away from work or leisure. They also may experience a wide range of daily work and social pressures from supervisors, co-workers, and subordinates that may take immediate precedence over the more long-term goals of the training.

Figure 4: Workplace Performance Model

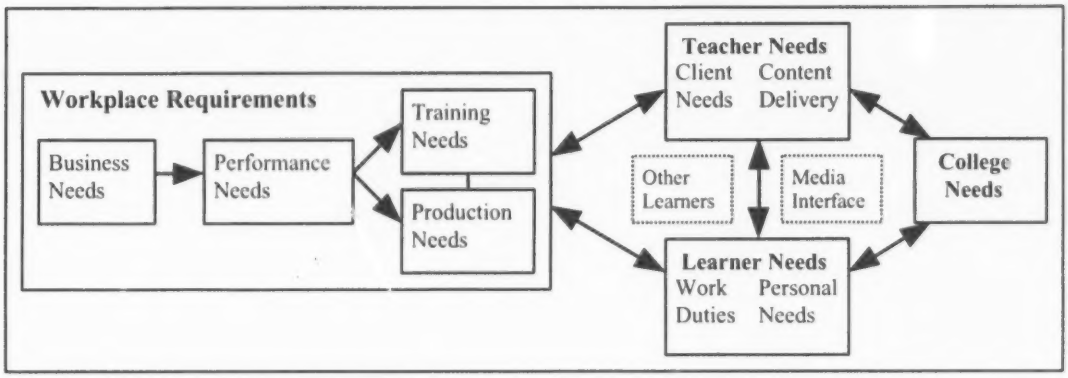


Source: Adapted from Robinson & Robinson, Performance Consulting, Barrett-Koehler, 1996.

Other workplace institutional issues which impact the tension between the individual's need to learn and the organization's need for performance include organizational readiness for the worker to learn, degree of supervisors' support, and organizational rewards and sanctions for the learning.[5] Instructors may need to interact with people in several business departments: human resources, the learner's work group, and the information technology group.

To appreciate the complexity of developing an asynchronous learning network for the workplace, a learning model for the workplace must incorporate the theories from Figures 1, 2, 3, and 4 to show the various sets of needs and institutions within which the learner learns and the teacher prepares and delivers the course material. This model demonstrates the tension felt by an individual who is striving to meet the organization's performance needs through both the long-term training initiatives and the near-term demands of daily production. The complexity increases with the number of businesses whose employees are involved in the course delivery.

Figure 5: An Asynchronous Learning Model for the Workplace



Source: Adapted from Figures 1, 2, 3, and 4.

Implications. The development of asynchronous learning networks for small and medium manufacturers is a complex process. Each individual student is learning not only within the limits and strengths of his or her own cognitive and affective skills, but is being challenged to learn new things in a way that impacts business performance. At times, there will be tension between what the learner needs to learn and what the business needs to have happen. For these educational programs to be successful, policy makers must ensure that the teachers and program developers are able to:

- Have the resources to conduct needs assessment with clients and potential learners.
- Have the appropriate development time.
- Help the learners develop the cognitive, affective, and physical skills to negotiate the various interactive skills necessary to learn in asynchronous modes.
- Help the learners balance personal and institutional pressures successfully.

III. Learner Characteristics – Learning Readiness and Learning Barriers

Creation of asynchronous learning networks for manufacturers will present developers with a challenge. Smaller manufacturers and other businesses will require high success rates in order to support the programs. However, in the academic setting, attrition (or drop-out) rates are higher among distance learners than they are with students in traditional classrooms. While much of the drop-out rate is attributed to environmental and situation stresses related to changes in personal, family, or work life, experienced distance learning practitioners generally believe that the "better" students do better in asynchronous learning settings, and that "poorer" students should be screened out. That view, even though it is grounded in experience, is unacceptable for community colleges who sense urgency in harnessing emerging technologies to provide essential workforce development services, and whose target populations may have different learning profiles than the elite academic.

Understanding the dimensions of success and failure – both in terms of learners' personal issues and technical delivery issues – becomes critical for assessing the barriers which might face the target population in the manufacturing setting. This section will summarize several studies which focus on the learner, including students' self-assessment of successes and problems, attrition studies examining cognitive and affective learning styles, persistence studies looking at perceptions of academic self-confidence and self-directedness, and a brief analysis of distance learners' attitudes about power.

Caveat: *The case studies and surveys cited here are all extremely limited in their sample sizes and diverse in their methodologies. Care needs to be taken in extending results to general populations. For the purposes of this literature review the results are directional, and can be used to develop hypotheses to test with specific populations and applications.*

Distance Learners' Perception of Success. Hardy and Boaz (1997) surveyed 200 academic distance learners across the United States and Australia to determine the students' own perceptions of what's required for success in distance learning.[6] These students believed that they needed to be more independent, assertive, self-disciplined, and motivated than the average college student. "It is almost a requirement that distance students be more focused, better time managers, and able to work both independently and as group members."[7] These successful students did experience institutional nuisances; they included problems related to distribution of course materials, communication with instructor, financial aid availability, and lack of knowledge about instructional policies. These successful students felt distance learning could be improved with more information about teacher expectations, more information about how to interact with the teacher and other students (questioning and networking skills), and student handbooks providing relevant institutional information.

Retention and Attrition as a Function of Locus of Control and Cognitive Learning Style. Dille and Mezack (1991) used a sample of 151 community college students (from a total of 188 students) taking video "telecourses" (prepackaged programs broadcast via cable of television) to study retention and attrition based on three factors: locus of control, learning style, and demographics.[8] Students defined as "academically unsuccessful" were students who either withdrew from the class before completion or who received a grade of D or below. Successful students completed the class with a grade of C or better.

- Locus of control is an affective variable assessed with the Julian B. Rotter's Internal-External Locus of Control Scale. It measures the beliefs of individuals about their environment and their expectations about how reinforcement is controlled.
  - A person with internal locus of control tends towards the belief that "achievement or academic success is due to their own abilities or efforts."
  - People with external locus of control tend to attribute success to luck or other external factors, such as the control of "powerful others".
  - On average, the 43 non-successful students all exhibited a higher sense of external locus of control than the average scores of the 108 successful students. The Rotter scale was also useful in predicting grades.
    - Researchers hypothesize that people with internal locus of control are more likely to be successful in work that requires a high degree of self-discipline.
- Learning (or cognitive) style is measured by David A. Kolb's Learning Style Inventory. It measures cognitive style preference on two continuums: Concrete Experience to Abstract Conceptualization and Active Experimentation to Reflective Observation. Results fall into four quadrants: Converger, Diverger, Assimilator, and Accommodator. *[Note: The meaning of these last terms is not necessary for this report.]*

- The scores measuring Concrete Experience (CE) were higher for the non-successful students. According to the study, high scorers in CE relate better to people and might miss the social interaction more than people who are higher in Abstract Conceptualization (AE).
  - Researchers hypothesize that the less concrete one's learning style, the better suited one is to learn in the telecourse (broadcast) environment.
- Actual learning style was not predictive, although Accommodators and Convergers who had relatively higher active experimentation scores ranked higher in success than Assimilators and Divergers who ranked higher on reflective observation.

- Demographics were analyzed to determine additional predictors of success.
  - Variables that were significant in predicting success were: grade point average, age, and marital status.
  - Variables that were not significant in predicting success were: sex, ethnicity, number of children, number of credit courses in current term, reason for taking the telecourse, previous telecourse experience, and importance in taking the course.
- High risk student has as a profile: 25 years old or younger, divorced, fewer than 30 college credit hours completed, a GPA lower than 3.0 – 2.9, a higher than average Rotter score and a higher than average Concrete Experience (CE) score, and a lower than average Abstract Conceptualization (AC) score.

This study leads to several hypotheses about the CCCOES target population for this grant. (1) The people in the target population might have profiles closer to this study's "academically unsuccessful" student. (2) People in the target population are likely to have been unsuccessful in their previous academic experience (high school or below), they are likely to have an external locus of control, and they might enjoy more concrete, more social learning styles than the Dille study's "successful" students. (3) A concrete learning style is probably a "good" in a manufacturing plant. (4) An external locus of control is likely to be subtly reinforced in a hierarchical, production environment.

Academic Self-Concept. Academic self-confidence is a concept related to persistence, which describes the individual's perception of his or her own ability to succeed. Over the course of one year, Gibson (1996) studied sixteen students taking external degree courses in an unnamed college with the intent to understand issues related to attrition and persistence.[9] The majority (87.5%) were women between the ages of 30 and 45 with one or two dependents employed outside the home at least 50% of the time. Students were interviewed every month for three months, than every six weeks for eight months.

In general, Gibson found that academic self-confidence was a dynamic variable fluctuating on a range of situational and institutional factors. Two major negative impacts on self-concept came (1) from students who expected that distance education would be easier than classroom education, and were unprepared for it to be more difficult, and (2) from students who had difficulty identifying teacher expectations. Both situations were self-concept detractors.

Figure 6: Academic Self-Concept Enhancers and Detractors

Course	Self-Concept Enhancers	Self-Concept Detractors
Process	- Teacher empathy with student - Early success in doing work - Success in meeting personal long-term goals (e.g., course is part of a longer program)	- Unfamiliarity with distance learning expectations - Unexpected requirements for responsibility and autonomy - Deficient study skills - Deficient reading skills - Stress of balancing home and study
Content	- Success in taking placement exams - Early success in mastering content	- Not figuring out expectations for test-taking, assignments - Taking on too many courses - Not meeting goals

Source: Gibson, "Toward an Understanding of Academic Self-Concept in Distance Education," The American Journal of Distance Education, 1996.

Tied to the academic self-concept is the ability to engage in self-directed learning. Academic distance education puts a high measure of responsibility on the student to be self-directed, and in charge of many decisions about the educational process. A willingness to be self-directed may be a function of the internal locus of control attribute studied above, as well as the student's self-assessment of his or her ability to learn. However, unexpected responsibility in this area has a negative impact on self-concept. The pressure to be self-directed adds to the other pressures that impact learning. In addition to worrying about teacher and family expectations, students worry about the expectations of supervisors and coworkers. Kasworm (1992) suggests that adults entering new and stressful educational situations prefer high instructor control and low student autonomy in order to gain an understanding of the teacher's expectations, assessment style, evaluation criteria, and general wants.[10]

Attitudes about Power. Evans (1994) assesses the learning stories of ten long-distance learners in the United Kingdom to evaluate their encounters with issues of power and control.[11] He theorizes that while distance learning promises flexibility and autonomy, the courses are still highly structured, scheduled, and constricted by the demands of pre-programmed curriculum. Students who had difficulty interacting with the power structure (e.g. teacher) in traditional education may not have learned the use of personal interactive skills (confronting the teacher, challenging curriculum requirements that don't make sense, working through institutional red tape). Evans also suggests this timidity may actually increase when an employer is involved, and there is concern that confrontation will have a negative impact on status within the learners' workplace.

Attrition in a Manufacturing Asynchronous Learning Project. Regional Technology Strategies has the project closest to the concepts being examined by the Colorado Community College System. Their initial 1995 grant from the Sloan Foundation targeted the development of technical course work aimed at manufacturing technicians in rural areas and in small- and medium-sized firms.[12] Six community colleges converted seven courses as pilot projects. Courses developed included: digital electronics for industrial maintenance personnel; computer numerically controlled machine operation; one course in a series essential to pass the American Production and Inventory Control Society (APICS) certification exam; DC electronics and AC electronics; biotechnology; and advanced manufacturing processes for workers at a steel mill.

Content was delivered through a variety of Internet sites, tests, videotapes, CD-ROMs, computers with courseware, and some face-to-face meetings. Interaction among students come from computer-based conferencing systems, chat rooms, e-mail, telephone, and some in-person labs.

Data was collected from 35 students, six instructors, and nine company managers. The initial pilots incurred attrition rates ranging from 17% to 88%. Key factors for non-completion included work and personal obligations and technical difficulties stemming from low understanding of computers and the Internet. Regional Technology strategies has confirmed that their target – line employees in manufacturing – have the general barriers to learning that work against the recognized success patterns for distance learning.

Figure 7: General Results of RTS Sloan Grant – Phase I

Positive Results	Lessons Learned
- Students and instructors reported "significant" learning - 85% would not have taken a course if it had not been offered on-line - 83% of students said they would take another ALN course - 88% of managers said that their companies would participate again	- Levels of interaction between students and faculty were lower than planned - The existence of communication systems does not ensure collaboration - Students need orientation on how course should work and technical support to address their limited computer experience - High tech solutions were not always effective. Graphics took too much time to download. Complex course and technical problems confused students

Source: Cynthia D. Liston, "On-Line Education and Training from Industry: Results from a Sloan Foundation ALN Project," Regional Technology Strategies, Inc., 1997.

From their first pilot studies, RTS is funded to develop ConnecTech, a clearinghouse for two-year colleges to share knowledge and courses related to working with small and medium companies. New programs include a series of international trade courses, a course on electronic commerce networks, expansion of the biotech training, and professional development.

Future plans to improve the quality of learning and lower the attrition rates include:

- Separate pre-qualifying courses (perhaps a certificate program) focused on training in the use of the technology.
- Required weekly interactions where everyone in class is on-line together (to improve collaboration).
- Encouraging students to build their own home pages.
- Ensuring that instructors set clear ground rules and give timely feedback.
- Creating more group activities and group projects to stimulate peer pressure and encourage collaboration.

Implications. The evidence would tend to support a theory that the potential for distance leaning success is greater for people who have already achieved some measure of academic success, who see themselves as in control of their own destiny, and who have a learning style that favors abstract learning over concrete learning. Hypothetically, the target learner population might not share the characteristics of what makes for a successful distance learner. The target population is more likely to contain concrete learners, to have an external locus of control, and low academic self-concept.

The institutional problems (e.g. figuring out teacher expectations, problems with materials, difficulties with technology) are apt to occur in the first few weeks of instruction. Where the "successful" student sees these institutional problems as nuisances, the student who has not had academic success experiences those barriers as assaults on self-concept. In this environment, the teacher becomes more of a partner with the students in helping them not only to acquire the course material, but also to negotiate a range of learning issues.

These issues indicate a need to place high attention on the structure and quality of instruction, especially on the early interactions with the system. Suggestions include:[13]

- Student orientation that describes the distance learning process.
- Clearly stated expectations with examples of acceptable work.
- Study skills, time management, and stress management programs.
- Early, easy assignments with quick feedback to achieve basis for success.
- Early telephone calls with teacher.
- Self-assessment tools.
- Working out media access and delivery "bugs" before classes begin.

IV. Development of Quality Instruction – General Overview

While asynchronous education holds great potential to solve some of the training issues facing small and medium manufacturers, it is also clear from the research on learner behavior that successful asynchronous programs will require specialized technical skills to enhance the quality of instruction and overall experience for students. This instruction must take into account the wide variance among students' cognitive and affective learning styles, the increased transactional distance, the need to mediate the four types of learner interaction, the business needs of the various participating manufacturers, and the reliance on different media interfaces for communication. Policy makers prompting development in this area must ensure that their program and resource decisions will enhance the learning ability of the targeted learner group.

The Secondary Role of Media Technologies. Media technology decisions are, of course, important in asynchronous learning networks. Whether the medium is video, audio, telephony, or on-line, media interfaces are used to access and deliver different types of learning. However, it is important to separate the reality of media from the hype. Every time a new medium arrives on the scene, its promoters rave about the potential educational benefits. Computer on-line technology has been no different. However, the evidence would show that technologies in and of themselves make no significant difference in the learning process. A bibliography of almost 250 studies conducted from 1936 to the present evaluating whether use of various media technologies are key variables in determining student success on various distance media would indicate that technology in and of itself does not make a significant difference in the learner's success (Russell, no date).[14]

The Primary Role of Instructional Competence. The relative success of distance learning programs is a complex of many other factors, such as learner characteristics and technical instruction design and delivery skills of the people who prepare and teach these courses. The relationships between the learners and the teachers are mapped in the various models in Section II above. The four core technical areas in instructional competence which impact the quality of asynchronous education are described in the following sections:

- Teacher competencies (Section V)
- Instructional design (Section VI)
- Course guide design (Section VII)
- Effective selection and use of media interface technology (Section VIII)

It is critical for the success of asynchronous learning that policy makers recognize and value the importance of these skills.

V. Teacher Competencies

The teacher plays a critical role in the evolution of asynchronous learning. A traditional model of education holds that learning is a shared enterprise between teacher and student united towards a common goal, with a strong emphasis on the oral tradition as a means of communication (Keegan, 1996).[15] In asynchronous learning, as in traditional classroom teaching, the teacher provides subject matter expertise, the opportunities for students to demonstrate their learning, and feedback in the form of comments, grades, and/or credits. However, the act of teaching (and the art of teaching) are separated by time and space from the act of learning. The material are developed and delivered to the student for the student to access and use at his or her convenience. The oral communications are greatly reduced.

In asynchronous learning, the teacher's methods must change. The review of learner characteristics (see Section III above) shows how critical the communication of clear teacher expectations is to learners' self-confidence. In programs developed for specific work environments, the teacher also helps the students understand the business' expectations. The teacher helps students overcome the transactional distance barriers by actively structuring and facilitating interactions. The teacher also helps model the techniques of collaborative learning that are essential parts of working with the wide variety of asynchronous networks arising in business (e.g., purchasing, production, marketing, and distribution networks).

From four different surveys of distance practitioners, Cyrs (1997) identifies six core competencies for distance educators[16] which can be summarized in three categories: content development, learner interaction, and group interaction.

Content Development. Content development competencies include not only subject matter expertise, but also the knowledge of how to build that course for an asynchronous environment, how to build strategies for student and group interaction into the course, how to use various delivery technologies, and how to manage the complex logistics of multi-site delivery. For workplace content development, the teacher must understand the context (or features of the "real world")[†] in which the learners will use the material and create situations for the learner to actively engage in application of the knowledge.[17]

[†] The active use of the subject matter context and application is the focus of the "constructivist" theory which will be described in later sections.

Figure 8a: Content Development Competencies

Core Competence	Description
Subject Matter Expertise	- Show solid mastery of subject - Understand how learners will learn subject matter - Know how learners will use subject matter - Use examples, analogies, visuals, graphics, and other props

Course Planning and Organization	Theory
	- Understand strengths and weaknesses of various technologies
	- Know instructional development and systems theory
	- Know how learning theory can improve distance learning
	Technique
	- Plan logistics
	  - Gaining copyright permissions
	  - Use of site coordinators
	  - Getting materials to and from sites
	- Build interactive teaching/learning strategies into course
	- Use the various technologies effectively

Source: Cyrs, Teaching and Learning at a Distance, 1997.

Student Interaction. Overcoming the transactional distance barriers to elicit successful student engagement is at the heart of the work of asynchronous teaching. Competencies include the ability to organize the formal delivery of material as well as the ability to structure and manage the synchronous or asynchronous discussion time.

Figure 8b: Student Interaction Competencies

Core Competence	Description
Verbal and Nonverbal Presentation Skills	Organization - Construct an organized presentation - Coordinate presentation with study guide and handouts - Manage discuss among multiple sites Learner Engagement - Project enthusiasm - Pace a lecture/presentation/dialog for audience - Use keywords and phrases to help students focus - Operate with significant reduction in feedback cues from learners - Use various media to influence learner's perception of instructor
Questioning Strategies	Interaction Design - Construct questions for different learning levels and teaching goals - Establish ground rules for asking and answering questions Interaction Management - Move among the learning levels while questioning - Signal to various locations the time to respond - Encourage students to ask questions of teacher and each other - Provide feedback

Source: Cyrs, Teaching and Learning at a Distance, 1997.

Group Interaction. The teacher also needs to design exercises that help students of different learning styles work individually or together, either at each site or across multiple sites. This interaction provides social interaction, lesson reinforcement, and opportunities for application of new knowledge.

Figure 8c: Group Interaction Competencies

Core Competence	Description
Collaborative Teamwork	- Help students work in teams at sites and across distance - Incorporate their process and findings into course
Involving Students and Coordinating Field Site Activities	Logistics - Maximize student activities at several sites - Manage times activities and exercises without being present Exercise Design - Select, design, and adapt exercises to match cognitive and affective behaviors and characteristics - Make exercises clear enough to engage students without direct supervision

Source: Cyrs, Teaching and Learning at a Distance, 1997.

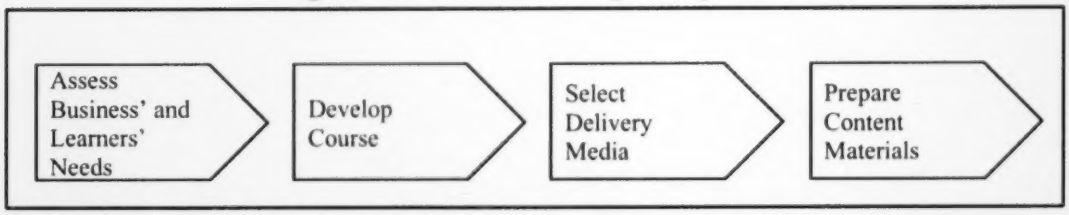
Implications. Asynchronous learning programs require that teachers acquire new sets of competencies and different kinds of supporting resources in order to create effective learning experiences. When policy makers support asynchronous learning strategies, they need to assure that teachers have the essential resource support to experiment with new ways to keep the learning materials and learning experience linked. That linkage is critical in workplace-related courses where the learning is to be shared with the enterprise in some way – by action, by modeling to others, or by applications.

VI. Instructional Design

The work of instructional design is highly related to the teaching competencies described above. However, due to the complexity of the interface design and the need for specialized structures, the course designer and the instructor might be different people. Unlike classroom teaching, most elements of instructional design must take place before the class begins in order to ensure adequate production time and to provide students with clear objectives. Late delivery of materials or poor articulation of expectations can adversely impact student success. Therefore, course designers must assess student and business needs, determine the learning prerequisites, ascertain the actual skills or competencies that will be taught, create the content, schedule material production time, choose delivery media, resolve any issues related to technology infrastructure, write the study guide (described in Section VII), and deliver the materials. With this work done in advance, the instructor is "free" to concentrate on delivering content, dialoging with students, and guiding the collaborative learning.

Course Design Sequence. The general rule of thumb in asynchronous learning is to understand the learners' educational needs before developing the course and selecting the technology. If business employees are involved, the business' goals and performance objectives need to be understood at the beginning, providing the course designers input to develop content and material relevant to the students' working situations.[18]

Figure 9: Course Design Sequence



Source: Adapted from Robinson, Performance Consulting, 1996; Cyrs, Teaching and Learning as a Distance, 1997; Moore, "Is Teaching Like Flying?", The American Journal of Distance Education, 1993.

A red herring for some distance learning projects is to select the delivery media technology first, then create the course around that technology. When the technology is selected first, the needs of the learners and their employers may not be discovered or fulfilled.

Overcoming "Transactional Distance". A key challenge in instructional design is overcoming "transactional distance" (Moore, 1991).[19] As stated earlier, transactional distance describes: (1) the geographic separation of learners and teachers, and (2) the separation between the perception and understanding of the learners and the perception and understanding of the teachers. The two tools for reducing this distance are *"dialog"* and *"course design"* (or course structure). Dialog and course design vary from program to program – not from medium to medium. The type of educational program – not the type of media technology – determines the strategies for course design and dialog.

Figure 10: Transaction Distance Issues

	Dialog	**Course Design**
Description	- The interaction between the teacher and the learner. One gives instructions and the other responds.	- How the teaching program is structured to be delivered through various media (print, lecture, video, computer, etc.). - The medium choice impacts the rigidity or flexibility of the program.

Determinants of Success	- Philosophy of the person designing the course.
	- Personalities of teacher and learner.
	- Subject matter of the course.
	- Environmental factors (including communications medium).
	- Actual interaction between learner and instructor.
		- Content.
		- Level of instructor.
		- Learner characteristics:
		  - The amount of autonomy the learner can exercise.
		  - Ability to analyze content.
		  - Personal learning objective.
		- Type and frequency of exercises.

Reduction of Transactional Distance	- Increasing dialog. (Ex: adding teleconferencing to a video delivery)	- Well-structured printed support material.

Source: Moore, "Distance Education Theory," The American Journal of Distance Education, 1991.

Increasing Student Autonomy. A key relationship exists between transactional distance and learning style – especially the amount of autonomy and self-directiveness the learner can exercise on his or her own (Moore, 1994).[20] The lower the amount of autonomy exercised by the learner, the more dialog and structured support needs to be built into the program. Instructional design must identify the required entry-level cognitive and affective skills and provide a structure for students with varying degrees of readiness. Moore also believes that integration of local needs and interests from each program delivery site and assigning group projects from each learning site helps strengthen both student autonomy and student interdependence.

Using a "Constructivist" Approach. A growing body of thought suggests that a "constructivist" approach to instructional design is effective in adapting technology, especially computer technology, to academic and workplace applications. The constructivist approach focuses on problem-solving and application of knowledge. Constructivists believe that knowledge cannot be transferred, that individuals actually build or construct new knowledge through interactions with their environments, and that learning is highly social.[21] Jonassen (1995) describes the four attributes of constructivism:[22]

Figure 11: Four Attributes of Constructivist Course Design

Attribute	Use in Design	Implication
Context	Case-based problems featuring actual setting in which task might be accomplished.	Includes the physical, market, cultural, social, political, and power issues, as well as technical skills.
Construction	Exercises allow learners to experience, articulate, and create their own meaning, based on their own experience.	Heavily oriented towards applied problem-solving.
Collaboration	Discussion with others to test and evaluate different beliefs and ideas.	Focus on building new strategies for employing knowledge based on learners' experiences.
Conversation	Individuals and groups must negotiate plans for problem-solving.	Promotes concept that people learn by talking and using language.

Source: Jonassen et. al., "Constructivism and Computer-Mediated Communication in Distance Education," The American Journal of Distance Education , 1995.

Constructivists believe this structured approach to "learning-by-doing" breaks down some of the weaknesses inherent in many software-based multimedia instructional designs – namely, that poorly-designed multimedia programs often exponentially increase the passive transfer of information in such a way that newer learners get lost in unproductive browsing (Dede, 1996).[23] A constructivist approach provides the context and structure for applying new knowledge. The approach also resembles the process by which problems are often solved in business.

Matching Instruction Style and Technology to Student Needs. A University of Texas program delivered algebra classes to migrant students through audio-conferencing (Schmidt, 1994).[24] Classes targeted high school students in small, rural school districts who had poor or

failing grades in algebra. The pilot class had 13 students (finishing with an 88% average), the second year had 36 students in 4 sites (finishing with a 92% average), and the third year had 56 students in classes (completed with 90%). The keys to success included:

- *Selection of a "constructivist" institutional approach* to mathematics that requires the learners to create their own "interpretation of mathematical meaning." The teacher constantly asks questions, and the students must respond with narrative and description. Its application here required students to talk descriptively about algebraic concepts.

- *The choice of "simple" telephone technology* allowed more schools to participate. Students needed no special technical ability. Teachers could call in from anywhere. Guests were accommodated. The lack of visual communication required teachers and students to work extra hard at making algebra practical and concrete.

- *The listening skills of the teacher* provided the critical control element. In an audio environment, the teacher needs to listen carefully and establish voice recognition with each student. The teacher needs to poll students constantly and maintain a communications log of interactions with students.

- *Onsite facilitators* helped students with logistics and with problem-solving.

This case study, while limited in scope, implies that good instructional design can create successful distance learning programs for people who have not had success in school. In this example, the instructor followed the basic course design model, selecting both the educational approach and the interface technology after a needs assessment. The lack of visuals required that both teachers and learners avoid abstractions. These students (who were not achieving in traditional education) responded well to this methodology.

Instructional Design Tips from Corporate Trainers. Helpful distance design hints also come from people involved in designing and delivering corporate distance learning. Abernathy (1997) suggests methods for developing and delivering distance learning targeted to the adult corporate learner:[25]

- Establish goals.
- Select technology which best matches goals.
- Insert "creative and engaging" interactive activities every five to seven minutes.
- Provide clear directions for how to communicate using media.
- Humanize instruction – use icebreaker exercises – use student names often, encourage them to call each other by name.
- Manage participation with short activities closely oriented to program goals.
- Actively give feedback and solicit feedback.

Implications. Asynchronous learning networks, which promise a high degree of flexibility for the student, may actually require a high degree of up-front client needs assessment and structural design in order to make that flexibility transparent. Design structure is also critical to provide the teacher with the tools and strategies to help bridge the gap between varying degrees of learner needs and the business objectives of their employers. Design approaches which include entertaining case studies and applied problem-solving may be specifically attractive to busy manufacturing line employees.

VII. The Study Guide

Distance educators have identified the need for study guide books which are distinct from the textbook or course content. The study guide is viewed as a surrogate for all the hints the teacher gives during a traditional class.[26] It is a tool for reducing transactional distance. The guide should be organized into coherent units and written in informal conversational style, have plenty of white space, and include some of the difficult concepts, personal anecdotes, examples, and points of disagreement. It should include teacher expectations, study hints, and course logistics.

Figure 12: Basic Study Guide Content Requirements

Expectation Setting	Skills Coaching	Logistics
- Statement of goals and objectives for course - Instructor's comments - Explanation of grading/evaluation scheme - Explanation of graduation and completion requirements	- Good study techniques - Suggestions for practical activity outside the course - Advice about preparation and submission of assignments - Self-testing questions or issues to be discussed	- Directions for working with the media and materials - Schedule of when lessons are to be completed - How much time to allow for each session - How to contact tutor or counselor

Source: Moore, "The Study Guide: Foundation of the Course," The American Journal of Distance Education, 1997.

Study guides are used in many developing countries where distance education is part of the mainstream and distance educators are more accustomed to working with people at all learning levels. Educators at the Open School in the Wazipur Industrial Centre in New Delhi, India, emphasize the role of the study guide in helping vocational students regulate and organize studies. Self-diagnostic tools and hints on organization and study tips are important.[27]

Figure 13: Wazipur Industrial Centre Ideas for Study Guide

Diagnostics	Organization	Technique
- Self-check test to assess whether or not student is ready for course - Self-check exercises with explanation about their importance for learning - Cheery cartoons	- Flow chart suggestion study sequence and techniques - Page numbers of each reading assignment - Clear summary of each section of a unit lesson with clear links to previous sections	- Average number of pages to study each day - Note-taking techniques - Notes on study habits including establishing a time and place, managing family interruptions - Studying with others

Source: Asia and the Pacific Programme of Educational Innovation for Development, Sharing Innovative Strategies for Self-Learning Materials, 1988.

Implications. The design of a study guide stresses the importance of providing students directions for understanding course expectations and managing common logistics issues. For students working on business-related courses, a study guide might include:

- A letter of welcome from officers of the business.
- Clear statement of links with business objectives.
- Names of on-site coordinators and technology support people.
- Discussion about how to apply distance learning techniques to business problems.
- Mini-cases showing workplace applications.
- Hints on how to have co-workers help with study.

VIII. Effective Use of Delivery Media Technology

All asynchronous learning networks are dependent on various forms of technology to enable access to and communication of information and learning. Although distance learning research shows that the use of a specific technology is not the critical determinant in the success of a specific program,[28] the effective selection, design, and use of various delivery media technologies can enhance or detract from the students' experience. The medium choice does impact the rigidity or flexibility of the course.[29] Naïve use of a specific technology – especially at the beginning of a program – can raise learning barriers for students.

Selection of Delivery Media Technologies. Delivery media include: print, mail, broadcast video, video cassettes, audio cassettes, fax, radio, telephone, telephone conferencing, video conferencing, computer-based training (programs on hard drive, disk, CD-ROM, or CD-I), on-line computer conferencing, e-mail, Internet access, voice mail, and many others. Selection of appropriate media is made for a variety of reasons:[30]

- Impact on Students
  - Expected learning gains
  - Ease of use
  - Availability and accessibility
- Fit with course goals
  - Business objectives
  - Content delivery requirements
  - Communication and interaction objectives
- Fixed and marginal costs to develop, produce, deliver, and access.

Of all the electronic delivery forms, computer-based training and video conferencing are currently the most popular with corporate trainers (Bassi, 1997).[31] They cite faster delivery times, faster completion times, and higher retention rates with stand-alone, self-paced, multi-media courses than with instructor-led courses. While on-line delivery using the Internet, corporate intranets, and computer conferencing was still small in 1996, on-line training methods within corporations is expected to accelerate through 2000.

Although computer media currently have high visibility, media with simple interfaces, such as telephone conferencing and audio tapes, may be more accessible and less costly to use for a wide range of people. The University of the South Pacific in Suva, Fiji, found that audiotapes provide a low-cost-to-produce, easily-accessible complement to print delivery.[32] All students had access to tape players, and studio production time was much less expensive than for video. Use of complementary media can accommodate different learning styles and can increase the forms and types of dialog and interaction, necessary to shorten transactional distance.

[Note: A wide range of literature exists discussing the techniques of production for various media, including stand-alone computer-based training. The following section will focus only on a few issues related to learning barriers inherent to on-line technology.]

Computer/On-Line Media Issues. The research community, defense industry and information technology industries have been using e-mail, bulletin boards, news groups, and the Internet to access and exchange information for twenty years. On-line databases have been available for specialized academic and industry use since the mid-1960s. Educators (in disciplines that use computers heavily, such as computer science, engineering, and various sciences) have been engaged in some forms of computer education since the mid-1980s. However, the accelerated pursuit of on-line technology as an education medium by academics and businesses is recent, spurred by the 1994 introduction of the World Wide Web (which lowered barriers for accessing different systems) and the spread of personal computers into businesses and middle America.

Characteristics of On-Line Education. Despite much discussion about the potential for delivering video and audio through the computer, on-line education is essentially text media. It requires the ability to read and to keyboard. Instruction is often mediated through a highly transactional process, using bulletin board postings or e-mail to carry on a dialog. Computer conferencing can be either synchronous, with students and teacher all posting and reading messages simultaneously, or asynchronous, with staggered computer discussion on a particular subject extending over a week or more.

Technical Hurdles. Many developers underestimate the type of support – staff time and hardware – that is required to help students who are not hackers access and use communications networks. Boston (1992) found in a review of on-line courses at Houston Community College that dropout rates were highly correlated to the student's failure to connect to the college computer.[33] That school determined that on-call assistance was required for the first three weeks of class to help non-hacker students deal with the technical issues of access and connectivity.

Many institutions underestimate the equipment support that is required. Even New Jersey Institute of Technology, an early pioneer in computer learning, had a major systems problem in its project, funded by the Sloan Foundation, to develop ALN courses leading to a Bachelor's Degree in Information Systems and Computer Science. Heavy usage of computer mediation (200 people at a time) overloaded campus systems, slowing down access, and requiring unexpected investment in modems, lines, additional hardware and software.[34] This problem is typical among institutions beginning to offer on-line computer courses.

Cognitive, Affective, and Physical Hurdles. The need to read quickly and keyboard quickly may add complexity and barriers for some on-line students. Boston (1992) also found that the "poor" students tended to be slow keyboarders, poor readers, and have undisciplined study skills,[35] and that initial problems accessing their on-line classes increased the likelihood that they would be unsuccessful. His findings corresponded to those of Regional Technology Strategies (RTS) (see Section III above), which discovered that its students had a high degree of computer anxiety, which negatively impacted their success. Boston also found that students needed to get feedback about their progress on the computer conferencing from teachers at least three times a week, in order to reduce anxiety. Both Boston and RTS recommend a separate orientation course to help students learn how to use various distance technologies and practice usage skills in an environment separate from the main subject area.

New Learning Competencies. Eastmond (1995), after a series of in-depth interviews with a group of students who took an on-line Constitutional Law class and whose progress in other on-line classes was tracked, observed that students who were the most successful either already had networking background or had access to their "own" technical support person who assisted them with gaining these learning strategies.[36] Students were most frustrated with the failure to get timely feedback from asynchronous "threaded" conversations. Eastmond suggests that on-line students need an entire range of new cognitive skills and learning strategies to be successful in asynchronous courses.

Figure 14: On-Line Learning Strategies

Learning Strategy	Components
Gain familiarity with computer technology as a learning tool	- Computer and modem hook-ups - Communications protocols - Keyboard emulation - Upload and download files - E-mail processing - Getting on and off listservs - Computer memory increases
Determine frequency of log-on	- When to log-on to work and check others - How long to work on-line - When to log-off - Strategy for most effective approach to asynchronous dialogs
Seek task information and feedback	- Getting information and feedback from teacher and other students
Overcome information overload	- Dealing with multiple conversations - Determining what information to use, which to ignore
Avoid silence or being ignored	- Overcoming feeling of exclusion because no one responded to your comment
Deal with textual ambiguity	- Becoming clear in own writing - Working to understand and get clarification on other's writing
Decide on content and style of on-line contributions	- Composing contributions off-line or spontaneous ad-libs - Social manners and on-line etiquette - Keeping on-track with course objectives
Process on-line information	- Methods for reviewing and organizing the data

Source: Eastmond, Alone But Together, 1995.

Technology Learning Classes. Like Boston and RTS, Eastmond believes students need a separate class to learn these strategies, because during class, students are too focused on content to learn real time-saving methods. However, Eastmond found extra sessions were not well-attended, as students weren't interested in tasks that did not contribute directly to content areas and grades. Boston and RTS both believe that on-line performance for the non-hacker would improve with an orientation program which would include basic computer protocols, use of a simple text editor, and how to access computer support.

On-Line Teacher Competencies. Abernathy believes that the key to successful use of computer conferencing in corporate training is accountability on the part of the trainer, to assure that the exercises are worthwhile and tied to the course objectives, and accountability from the student to his or her organization.[37] Boston also focuses on the importance of the teacher's ability to manage the number of transactions or required interactions with the computerized material and the distance classmates.[38] New teachers frequently ask for more interaction than is necessary to meet course objectives. It is possible that people withdraw from interactive computer activity because they can't see the relevance for the course or work.

Another critical issue for teachers is the need to give students feedback on their work. Not only must teachers structure the class to manage the interactions, they must check on students' work and provide feedback at least three times a week. To run a computer conferencing session, teachers must be good typists and model clear expression.

ALN programs may also require teachers to deal with new institutional issues related to faculty load, faculty compensation, faculty support and training, supervision and training of adjunct faculty, and funding sources for additional course development.[39]

Successful Asynchronous On-Line Computer Programs. Despite the barriers listed above, asynchronous on-line learning has had some success – especially where professional development is linked with immediate practical use and the possibility of certification or degree:

- Professional development for nurses and other medical care people living in rural areas.[40] Cairns Rural Health Training Unit links 40 remote health care centers in Northern Australia and provides dial-up network training packages to assist the nursing staff in serving patients. Success was measured by usage of packages with patients. Another project in western Alaska provides Internet links and asynchronous messaging for health clinics staffed with health aides with about one year training.

- Higher education classes targeting students in computer science, engineering, and various sciences – programs where students are oriented towards use of technology and where the traditional curriculum is already highly structured, lending itself to the structured format of distance learning. New Jersey Institute of Technology's Sloan-funded development of ALN courses leading to a Bachelor's Degree in Information Systems and Computer Science was perceived as successful by the students who completed the course. Success was measured by growth in enrollment, speed in getting a grade, access to professors, and quality of learning (Hiltz, no date).[41]

- Other programs with potential for success will be those developed in close partnership with trade association and/or business certification programs.

> Metropolitan State University in Minnesota is converting the introductory course of an existing certification program of the National Association of Purchasing Managers' Twin Cities chapter to an asynchronous offering.[42]

Professional accreditation in which an asynchronous learning program helps individuals work towards individual goals and improve their work performance could be an important hook. The discussion on self-confidence (in Figure 6 above) indicates that a student is more likely to stay with a course if it is not isolated, but its completion will satisfy a larger personal goal.

Implications. Understanding business goals and learner needs is a critical part of media selection, particularly for worker-learners who are in fast-paced manufacturing production environments. Access to asynchronous versions of established certification programs in work-related areas might be attractive to workers and their employers. Content strategy and media choices should enhance the type of information-sharing and problem-solving choices actually faced by the worker-learner and simplify the learning process. Every media requires specific competencies to use it – both as a teacher and as a learner. Now that use of on-line technology for education has moved beyond the realm of the computer hacker, providers of asynchronous learning networks may need to give students additional support in terms of media orientation classes, initial on-call computer support, and feedback from the teacher or tutor.

IX. Conclusion

Changing global markets and evolving telephone and computer technology are changing the ways in which businesses do business. These forces will require businesses to not only update their employee skills more often, but will require employees to engage in problem solving with customers, suppliers, and fellow employees in a variety of dispersed communication media. For educators, it is a logical move to develop educational processes (including asynchronous learning networks) employing those technologies. However, the evolution of networked computers as a tool for linking economic development and learning is still in its infancy. Community college and industry policy makers need to move ahead carefully to ensure that actual needs of businesses and the worker-students – not the requirements of a specific technology – drive the creation of new educational programs.

This study hypothesizes that the manufacturing line employees targeted in this grant are likely to have different learning needs and learning styles than the people who typically succeed at academic distance learning. Different types of media and combinations of media, as well as human interaction, may be more effective with different learning styles. The initial use of on-line computer technology does raise learning hurdles that are distinct from the content demands. These hurdles need to be addressed in curriculum design, as well as with staff and resource support.

Successful programs will be closely tied to actual problems encountered in the changing workforce. Participation will be sanctioned by the employer, and certification will be available. The materials will be application-oriented, and will help the individual understand how to gain new skills, use those skills, and share them. These courses many need to have basic skills built into them for some employee groups. Attending to these fundamental needs of employer and student will provide the foundation for helping these businesses adapt to their competitive world.

Endnotes

[1] Benjamin S. Bloom, Human Characteristics and School Learning (McGraw-Hill: New York, 1976), pp. 22, 30, 31, and 24. There are many different (and more recent) cognitive and affective learning models. Bloom's model was picked because his work, based on extensive longitudinal studies of learning behavior, was seminal to the whole discipline of behavior-based education theory.

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[15] Desmond Keegan, Foundations of Distance Education, Third Edition (New York: Routledge, 1996), pp. 77, 114.

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